LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

MASTER´S IN
MONETARY AND FINANCIAL ECONOMICS

MASTER´S FINAL WORK
DISSERTATION

GOVERNMENT BORROWING COSTS AND FISCAL DEVELOPMENTS

JOSÉ DIOGO SAMPAIO COMENDA

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ABSTRACT

In this paper, I examine the determinants of 10-year sovereign bond yield relative to Germany for a panel of 10 Euro area countries for a period between 1999 and 2019. Beyond the usual variables such as vix, real effective exchange rate, expected budget balance, expected debt-to-GDP and GDP growth, I studied the impact of fiscal rules and ECB monetary policy measures, namely the LTRO, SMP and PSPP. My work finds that, when tested individually, an increase in bid ask spreads, real effective exchange rate and expected debt leads to an increase in yield spreads while an increase in GDP growth and in budget balance leads to a decrease in bond yields. I also found that an increase on the average credit ratings have a negative impact on bond yields. Finally, in what it concerns with ECB quantitative easing I did not find any evidence of statistically significance.

Contents

1. Introduction

The idea of having coordinated economic and fiscal policies, a common monetary policy, and a common currency has been an ambition for the European Union countries since 1960. In 1992 the desire to create an economic and monetary union started to take shape when the Maastricht Treaty was signed by the leaders of the twelve countries who making up the European Community at that time (Belgium, Italy, Luxembourg, France, Netherlands, West Germany, Denmark, Ireland, United Kingdom, Greece, Portugal, and Spain). One of the Maastricht Treaty's priorities was economic policy and the convergence of EU member state economies. Therefore, the treaty established a timeline for the creation and implementation of the European Monetary Union (EMU). The EMU aimed to create a new economic ecosystem known as the euro area, which include a common economic and monetary union, a central banking system, and a common currency. After almost a decade of preparation, the euro was launched on 1 January 1999, although coins and banknotes were launched only on 1 January 2002.

Since the introduction of the common currency, we lived some turmoil periods that had an impact in sovereign bond yields. First, until the financial crisis of 2008, with the elimination of exchange rate risk, sovereign bond yields converged almost perfectly for the euro-area countries, however, following the 2008 international financial crisis, and notably after the Lehman Brothers bankruptcy on September 2008, the behaviour of sovereign spreads changed dramatically and government borrowing costs started to significantly diverge.

In the aftermath of the financial crisis, governments increased their expenditures, cut taxes, launched economic stimulus packages and therefore deficits and debt levels increased sharply and investors started to doubt the ability of certain countries to pay their debts and required higher credit risk premium. With bond yields soaring, we witnessed the emergence of a sovereign-debt crisis in several members of the Eurozone, namely Greece, Ireland, Portugal and Spain. In the Greek case, sovereign bond spreads had reached almost 300 basis points and by 2010 they had skyrocketed to over 1000 basis points.

Also during the sovereign debt crisis, we witnessed a dramatically increase in credit ratings importance on the assumption that credit rating agencies may disclose important information to financial markets about the creditworthiness of a country. Regarding this subject, Kunovac and Ravnik (2017) argue that policymakers are overrating the importance of rating agencies and rating agencies should not be overly important for public discussions even though the average reaction of spreads to rating announcements proved to be statistically significant.

The intensity of the crisis has prompted an extensive intervention on behalf of the European Central Bank (ECB) at various phases of the crisis in the European sovereign bond markets. Thus, in 2015, through an asset purchase programme, ECB implemented "quantitative easing" measures, extending the ECB's existing programmes of private sector assets purchases to include purchases of sovereign bonds. In early 2019, the bank announced another round of easing through targeted long-term refinancing operations (TLTROs), just months after the end of its opened-ended QE program. The TLTROs are Euro system operations that provide financing to credit institutions for periods of up to four years. They offer long-term funding at attractive conditions to banks to further ease private sector credit conditions and stimulate bank lending to the real economy.

This ECB's Asset Purchase Programme (APP) was introduced to boost lending, lift inflation rates to levels below, but close to 2% over the medium term and is part of a package of non-standard monetary policy measures that also includes targeted longer-term refinancing operations. Among the ECB´s Asset Purchase Programme we have three finished (Covered bond purchase programme (CBPP), Second Covered bond purchase programme (CBPP2) and Securities Markets Programme(SMP)) and four ongoing programmes (third covered bond purchase programme (CBPP3), asset-backed securities purchase programme (ABSPP), corporate sector purchase programme (CSPP) and public sector purchase programme (PSPP)). Since 2015 the Public Sector Purchase Programme (PSPP) has been the main instrument for Quantitative Easing (QE) in the euro area and despite the net asset purchases under the PSPP ended in 2018, the ECB

has communicated that QE will remain part of the toolbox in the future. It is foreseen as an instrument of monetary policy that will be used for contingencies.

Another important issue that might help to explain the behaviour of 10-year government bond yield of euro area countries is the ECB fiscal policy. In this regard, there is a growing empirical literature studying if fiscal rules reduce borrowing costs, more specifically through the excessive deficit procedure which introduced rules to avoid 'excessive' deficits and recommend that deficits should remain below 3% of GDP and that debt-to-GDP ratios should be below 60% or, at least, decline quickly towards that level and deviations from these rules could lead to financial sanctions being imposed upon a country. Since individual countries cannot use monetary and exchange rate policies, fiscal rules are particularly important in the European monetary union to answer to country-specific shocks, imposing long-lasting constraint on fiscal policy through numerical limits on budgetary aggregates.

The aim of this dissertation is to investigate the determinants of government bond yields relative to German bond between 1999 and 2019 in 10-euro area countries, namely Austria Belgium, Finland, France; Greece, Germany, Ireland, Italy, Netherlands, Portugal and Spain. After more than two decades since the single currency creation, the study of government bond yields and which determinants influence their behaviour continues to arouse a lot of interest.

Although it already exists a vast literature on the topic, this study remains relevant not only due to the vast range of variables that could explain the fluctuations of 10-year government bonds but also due to new data that continue to emerge over the years. Markets started to take into consideration additional variables especially after the eruption of the financial crisis. Among the group of determinants, which has received more attention in recent years, are the ECB monetary policy operations, the adoption of fiscal rules and the increasing relevance of credit ratings.

In order to study the determinants of the 10-year sovereign bond yields, I started to estimate an equation where I included the traditional determinants like the real effective exchange rate, vix, expected budget balance, expected debt-to-GDP, bid-ask

spread and GDP growth rate plus the average credit ratings which accounts for a simple average of the three main credit rating agencies (Standard & Poor's, Moody's and Fitch). In order to capture further insights regarding the movements of spreads in my 10 Euro area countries panel, I included a fiscal rule index to measure the strength of fiscal rules. This index covers all types of numerical fiscal rules, namely budget balance, debt, expenditure and revenue rules. The scope of information includes the description and definition of the fiscal rule and its coverage, its statutory base, monitoring bodies, correction mechanisms in case of deviation from the rule, as well as experience with the respect of the rule. Additionally, to capture the influence of ECB´s monetary policy measures, I included an equation in my study including the Longer-term Refinancing Operations (LTRO) and two asset purchase programmes, namely securities market program (SMP) and public sector purchase program (PSPP).

My study finds that, when tested individually, an increase in bid ask spreads, real effective exchange rate, expected debt and fiscal rules, leads to an increase in yield spreads while an increase in GDP growth and in budget balance leads to a decrease in bond yields. I also found that an increase on the average credit ratings have a negative impact on bond yields. Finally, in what it concerns with ECB quantitative easing I do not found any evidence of statistically significance.

This work is organized as follows. Chapter 2 reviews the literature on this topic, chapter 3 describes the methodology, and chapter 4 includes a detailed explanation of data set and explicative variables. Chapter 5 displays results and Chapter 6 concludes.

2. Literature review

According to Codogno et al. (2003) before the implementation of the EMU, yield differentials within Europe were determined by four main factors: expected exchange rate movements and exchange rate risk, different tax treatments and controls on capital movements, liquidity, and default or credit risk. Exchange rate factors were eliminated in January 1999 for EMU countries, and tax treatments were harmonized before monetary union, while controls on capital movements had been removed long before that. The other two factors, however, remain relevant.

Despite the fact that the literature on this topic is divided into two broad categories, covering the period prior to and following the global financial crisis, the existing literature is unanimous in pointing out that spreads of euro area government bond markets reflect three main variables: credit risk, liquidity risk and an international risk factor, as we can perceive, for example at Manganelli and Wolswijk (2009), Codogno et al. (2003) or at Favero et al. (2010).

Credit risk is the possibility that borrowers cannot repay the loan but in this case is the possibility of default on behalf of a sovereign borrower. Even though this risk tends to be low in European countries, defaults can still happen, and this risk need to be considered. See for example, Afonso et al. (2015), Afonso and Rault (2015), Ardagna et al. (2007) and Elmendorf and Mankiw (1999). Geyer et al. (2004) findings support the hypothesis that credit risk explains a substantial part of EMU government bond spreads.

According to Afonso et al. (2015) liquidity risk is the source of risk that refers to the size and depth of the sovereign bonds market and captures the possibility of capital losses due to early liquidation or significant price reductions resulting from a small number of transactions. Besides Afonso et al. (2015), Favero et al. (2010), Arghyrou and Kontonikas (2012), Gómez-Puig (2006), Jankowitsch et al. (2006) are some of the most important articles that approach the importance of this variable.

The international risk factor captures the level of perceived financial risk and its unit price. Typically, this is empirically approximated using indexes of US stock market

implied volatility or the spread between the yields of US corporate bonds against US treasury bills. That is the argument that Codogno et al. (2003) work defend. Their results also suggest that international factors are more important than liquidity for the determination of yield differentials in the Euro area (except France). While this result is obtained by simple regressions, Geyer et al. (2004) arrive at a similar conclusion but using a more sophisticated theoretical and econometric set up.

As I mentioned before, another point of consensus on this topic is that the financial crisis of 2008-2009 had a big influence on sovereign bond yield behaviour. This subject, fall into two broad categories, which cover the period prior to and following the global financial crisis. De Santis (2012) suggests that euro area countries with the largest government deficit-debt combination and therefore with the highest credit risk were the countries subject to numerous credit rating changes and mostly affected during the crisis. Afonso et al. (2014) considers a group of euro area countries between 1999 and 2010 and concludes that macro and fiscal risks priced by markets has been significantly enriched since March 2009, including international financial risk and liquidity risk. Afonso and Jalles (2018) conclude that the international risk factor (VIX) is price around 7–8 times more after the crisis and that liquidity is also a key determinant after the crisis. Mody (2009) and Acharya et al. (2014) findings support previous studies and argue that international risk factors were quite relevant during the crisis and have fed back via the financial sector. Mody (2009) also found that exposure to financial sector weakness was not an important determinant of sovereign spreads prior to the collapse of Bear Sterns in March 2008. Attinasi et al. (2009) and Barrios et al. (2009) achieve the same idea, which is that higher expected budget deficits and/or higher government debt ratios relative to Germany contributed to higher government bond yield spreads in the euro area during the analysed period. Barrios et al. (2009) also conclude that the impact of domestic factors on bond yield spreads increase significantly during the crisis, when international investors started to discriminate more between countries. Bernoth and Erdogan (2010) find that before the financial crisis, the coefficient of the deficit differential between the issuer country and Germany fluctuated around zero and was insignificant. After the intensification of the financial crisis in the end of 2008, the

coefficient of the deficit differential remained continuously positive and shows an increasing trend.

In the aftermath of the financial crisis, the European Central Bank started buying assets from commercial banks as part of its non-standard monetary policy in an operation called quantitative easing. Afonso and Kazemi (2017) findings suggest that the ECB´s quantitative easing measures have negatively affected 10-year sovereign yield spreads in the euro area, notably Longer-term Refinancing Operations, Targeted Longer-term Refinancing Operations and the Securities Market Program. Still in this topic, Kinateder and Wagner (2017) state that ECB´s quantitative easing has a pronounced spread decreasing effect. However, the authors note that the long-term consequences of such unconventional monetary policy may exhibit an inverse sign. Hence, the results do not exclude that longer-term financial stability could be negatively affected. Based on an event study on different asset price channel, Urbschat and Watzka (2017) found that the effects of the asset purchase program were strong in the first round but the marginal impact of every additional package decreased over time. They also showed that core countries usually have shown weaker responses and the reduction has been more pronounced for periphery countries. In another study regarding this topic, De Santis (2020) using a country-panel error correction model with Bloomberg news also conclude that the vulnerable countries benefited the most from quantitative easing. De Santis concludes that most of the impact occurred between September 2014 and February 2015, in line with the view that investors discounted the implications of the monetary policy before the actual purchases even started.

Afonso and Tovar Jalles (2018) using a panel of euro area countries over the period 1999.01–2016.07 also claim that ECB's intervention did contribute to contain sovereign yield spreads.

Afonso and Jalles (2016), using data from 10 euro area countries, assessed the determinants of government bond yield spreads and found that better fiscal positions or higher than expected growth prospects reduce the yield spreads, while increases in the VIX, bid ask, debt-to-GDP ratio or real effective exchange rate increase the spreads.

They also found that for the case of budget balance and real GDP, the larger (higher) in absolute value the corresponding spread's responsiveness, the lower the volatility and for the bid ask spread, the debt-to-GDP ratio, the real effect exchange rate and the VIX, higher spread sensitivities imply higher economic volatility.

Heppke-falk and Hüfner (2004) studied the impact of the projected budget deficit ratio for 12 months ahead on the swap spread for Italy, France and Germany between January 1994 and July 2004. The results varied with respect to countries and time, but they concluded that at least for Germany and France, the deficit ratio seems to exert an increasing influence over time and this outcome suggests that market discipline has become more important along with EMU membership. It is important to mention that this article do not studied the entire effect through which budget deficits can influence interest rates.

Afonso (2010) studied the effects of macroeconomic and fiscal forecasts on long-term government bond yields of 14 euro area countries between 1998 and 2008 and the results show that 10-year general government yields increase with better growth forecasts, and with decreases in the budget balance-to-GDP ratios, signalling that sovereigns need to pay a higher price to finance higher forecasted budget deficits.

Aßmann and Boysen-Hogrefe (2012) studied the oldest and the most important euro zone countries and their findings suggest that the expected debt-to-GDP ratio explains a major part of the differences in bond yields in the euro area between 2003 and the unfolding of the financial crises. The authors go further and state that most of the time, the debt-to-GDP ratio is the single most powerful explanatory variable. Likewise the previous article Haugh et al. (2009) work suggest that an increase in expected fiscal deficits is likely playing a large role in the increase in spreads across all countries. In another work, Costantini et al. (2014) results show that fiscal imbalances, namely expected government debt-to-GDP differentials, are the main long-run drivers of sovereign spreads. Gómez-Puig (2006) results support the existence of a non-linear relationship between relative debt levels and adjusted spreads, which was accentuated by EMU.

A similar result was found by Kumar and Baldacci (2010). They studied the impact of fiscal deficit and public debt on long-term interest rates over almost three decades between 1980 and 2008 and realized that large deficits and debt can have a marked adverse impact on bond yields, but that a variety of domestic and international factors are likely to determine the magnitude of this impact.

Robbins and Simonsen (2012) study the US state debt levels and borrowing costs over a six-year period (2001–2006) and the evidence founded does not indicate that the market extracted a penalty for increasing debt loads.

Another factor that increased its relevance to explain the government bond yield spreads were credit ratings. Afonso, Arghyrou and Kontonikas (2015) findings on this topic suggest that the role of credit rating agencies in spreads determination within the euro area is relevant, yet the inclusion of ratings and outlook announcements into the models does not result in any significant improvement of the models' fit and explanatory power compared to macro and fiscal fundamentals, which means that the role of ratings is limited. Afonso, Furceri and Gomes (2012) work show significant responses of government bond yield spreads to changes in rating notations and outlook, particularly in the case of negative announcements. Afonso, Gomes and Taamouti (2014) also addressed the credit rating topic and they show that sovereign rating changes have asymmetric effects on both equity and bond volatilities. The authors also conclude that it seems now that sovereign rating announcements create interdependence among European financial markets with upgrades (downgrades) in one country leading to a decrease (increase) in volatility of the other countries.

It is also important to mention that the major part of the articles presented in this section suggest that the relation between determinants and government bond spreads varies over time and that the relative importance of the determinants can change over time. The altering in risk pricing over time confirms the need of time-varying coefficient models in this context. Codogno et al. (2003), Bernoth et al. (2004), Afonso and Jalles, (2016) among others, are some of the examples of this approach.

3. Methodology

Regarding the model approach, I followed the existing literature, namely Afonso, Jalles and Kazemi, (2020), Afonso, Arghyrou and Kontonikas, (2015) and Afonso and Kazemi, (2017).

As mentioned before, I studied the 10-year sovereign bond yield against a commonly accepted benchmark, the yield on German government bonds for a panel of 10 Euro area countries. Hence, the sovereign bond spread is the difference between the sovereign yield of country i and the benchmark yield of Germany with the same maturity in t:

$$spreads_{it} = yield_{it} - yield_{DEt}. \qquad (1)$$

Therefore, the main regression equation is the following:

$$\mathrm{spreads}_{\mathrm{it}} = \alpha_{\mathrm{i}} + \rho_{\mathrm{t}} + \beta_{\mathrm{it}}\mathrm{X}_{\mathrm{it}} + \varepsilon_{\mathrm{it}}. \qquad (2)$$

Where $\mathrm{spreads}_{\mathrm{it}}$ denotes the 10-year government bond yield spread versus Germany. X_{it} is a vector of determinants, which, will be explained, in the next chapter, and the coefficient β_{it} measures the degree of sensitivity of sovereign spreads to a given determinant. α_{i} denotes country effects capturing unobserved heterogeneity across countries, and time-unvarying factors. ρ_{t} represents time effects and aim to control for global shocks. Finally, $\varepsilon_{\mathrm{it}}$ is a disturbance term satisfying usual assumptions of zero mean and constant variance.

Therefore, I present below the simplest version of my model, including some of the explanatory variables:

$$\mathrm{spreads}_{\mathrm{it}} = \alpha_{\mathrm{i}} + \rho_{\mathrm{t}} + \beta_1 vix_{it} + \beta_2 debt_{it} + \beta_3 balance_{it} + \beta_4 bidask_{it} + \beta_5 gdp_{it} + \beta_6 ratings_{it} + \beta_7 reer_{it} + \varepsilon_{\mathrm{it}} \qquad (3)$$

After the estimation of equation (3), I added a fourth and fifth equation aiming to capture further insights regarding the movements of spreads in my 10 Euro area countries panel. Thus, in equation (4) I will consider the strength of fiscal rules, which are measured by the European Commission's Fiscal Rule Index (FRI). This index combines

quantitative and qualitative characteristics of a country's existing fiscal rules and measures their strength. In equation (5) I will study ECB policy measures:

$$\text{spreads}_{\text{it}} = \alpha_{\text{i}} + \rho_{\text{t}} + \beta_1 vix_{it} + \beta_2 balance_{it} + \beta_3 bidask_{it} + \beta_4 gdp_{it} + \beta_5 ratings_{it} + \beta_6 reer_{it} + \beta_6 FRI_{it} + \varepsilon_{\text{it}} \quad (4)$$

$$\text{spreads}_{\text{it}} = \alpha_{\text{i}} + \rho_{\text{t}} + \beta_1 vix_{it} + \beta_2 balance_{it} + \beta_3 bidask_{it} + \beta_4 gdp_{it} + \beta_5 ratings_{it} + \beta_6 reer_{it} + \beta_7 LTRO_{it} + \beta_8 SMP_{it} + \beta_9 PSPP_{it} + \varepsilon_{\text{it}}. \quad (5)$$

The equations mentioned above are first estimated by Ordinary Least Squares with robust standard errors clustered at the country level. As I mentioned above, I consider specifications with and without country and/or time effects for robustness purposes. Time fixed effects are included to control for global shocks; country fixed effects are included to control for unobserved cross-country heterogeneity and time invariant characteristics (geography, institutional aspects, etc.).Then, due to potential endogeneity concerns of some of my variables in the vector, I rely on a Two-Stage-Least-Squares estimator to re-run equation (3), (4) and (5).

4. Data and Explanatory Variables

4.1. Data

I analyse a panel data containing countries that have adopted the single currency since it was first introduced in 1999, plus Greece and excluding Luxemburg. Thus, in addition to Germany, I analyse ten-euro area countries: Austria, Belgium, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

I will use annual data for the period between 1999-2019. Therefore, the sample covers several important economic events such as the introduction of the Euro in 1999, the financial crisis in 2007/2008, the European sovereign debt crisis and the European Central Bank's expanded asset purchase programme.

The dependent variable in my econometric analysis is the annual 10-year government bond yield spread relative to Germany. I used Germany as reference because German government bonds have been reinforcing their safe and benchmark status, even during the financial crisis, and also because German bonds represent relatively high credit quality and liquidity.

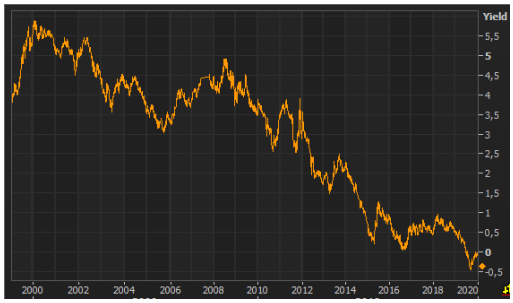
Regarding the behaviour of 10-year government bond yield of the countries that I will consider in my work, I might say that with the introduction of the common currency, sovereign bond yields stabilised at very low levels between 1999 and 2007, even though macroeconomic fundamentals were deteriorating in many euro area countries. With the outburst of the financial crisis, the outlook changed, spreads increased in all euro area economies due to the increasing fear of excessive sovereign debt and lenders started to demand higher interest rates from Eurozone states. In the aftermath of the financial crisis, due to the uncertainty about the solvency of some Eurozone members, yields began to diverge again particularly in the so-called peripheral group (Portugal, Ireland, Greece, Italy, and Spain). To counteract this trend, the ECB started buying assets from commercial banks in 2015 as part of its non-standard monetary policy measures known as quantitative easing. These measures presented a turning point in the euro area debt crisis and initiated a period of convergence in the

sovereign bond yields that last until the present. Nowadays euro area countries enjoy close to zero or even negative yields.

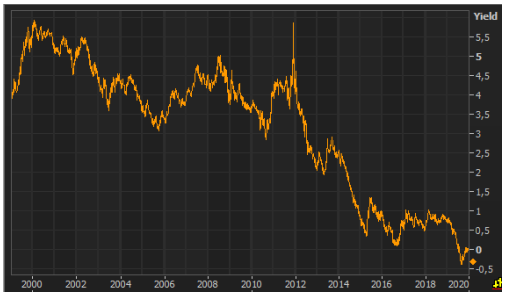
In the graphs below, Figure 1, we can perceive the evolution of 10-year bond yields between 1999 and 2019 in the target countries of the study.

Figure 1 - 10-year bond yields

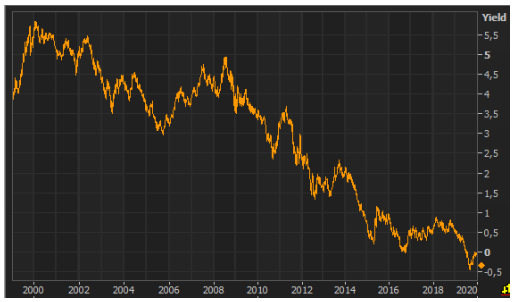
Austria



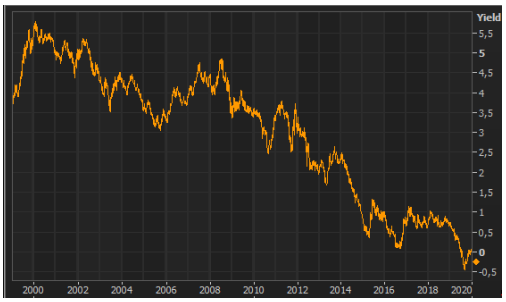
Belgium



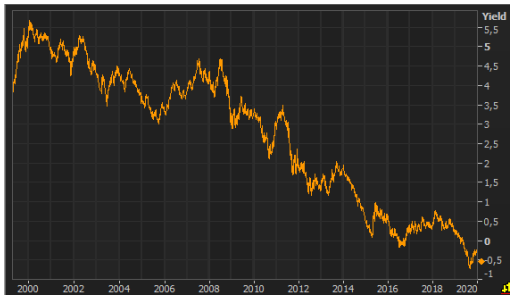
Finland



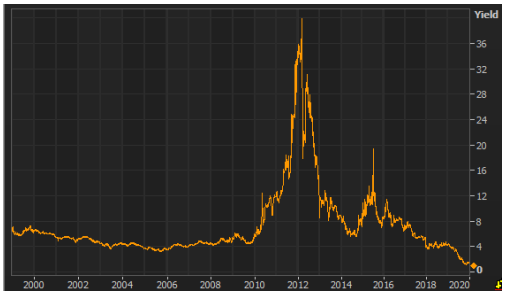
France



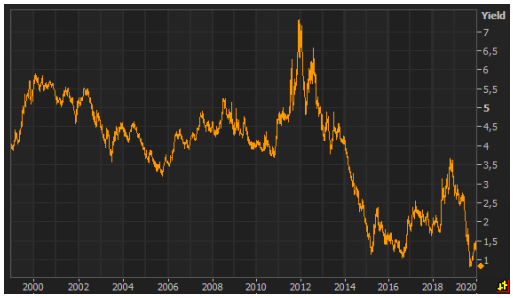
Germany



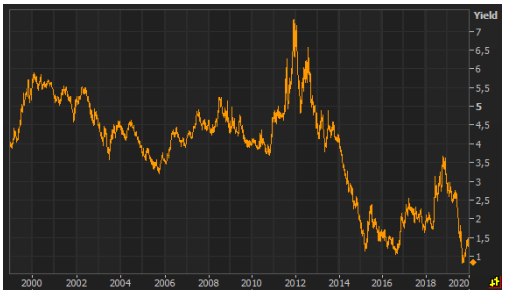
Greece



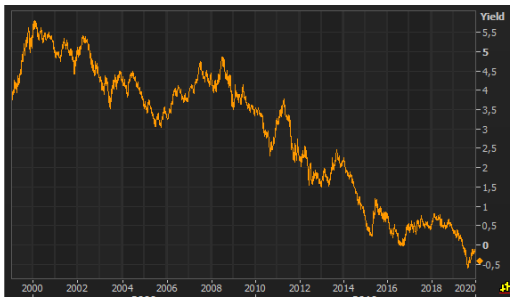
Ireland



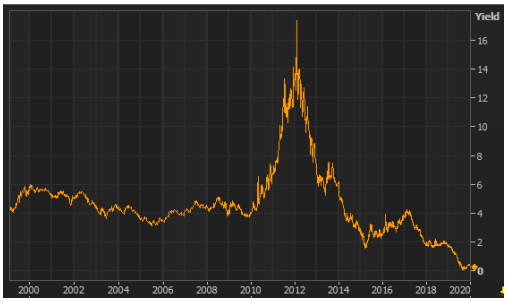
Italy



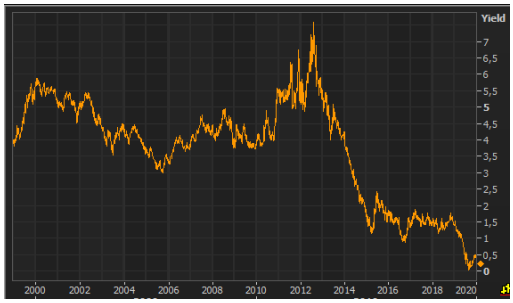
Netherlands



Portugal



Spain



4.2. Description of Explanatory Variables

Regarding the determinants of yield spreads, follows a description of all the explanatory variables and their theoretical relation to yield spread changes.

-vix_t is the Chicago Board Options Exchange Volatility Index that is adopted to reflect the international risk factor. It measures the "risk-neutral" expected stock market variance for the US S&P500 contracts, computed from the panel of option prices and has been used in the literature on euro area government bond spreads(see Beber et al., (2009) and Gerlach, Schulz and Wolff, (2010)). It is also known as the "fear index" for

financial markets as VIX tends to spike during market turmoil periods. It is expected to observe an increase (reduction) in the government bond spreads after a rise (decline) in the value of the international risk factor.

- $debt_{it}$ and $balance_{it}$ represent the expected government debt-to-GDP against Germany, and the expected government budget balance-to-GDP also against Germany, respectively, both one-year ahead. The magnitude of public debt and potential budget deficits affects the country's ability to pay and is therefore a measure for credit quality. Higher expected debt might be a signal for market participants for deteriorating credit worthiness. In what it concerns with public debt, it is expected that a higher (lower) value should cause an increase (decrease) in yield spreads. While it is expected that a higher (lower) value for the government budget balance will reduce (increase) yield spreads. The use of expected, as opposed to historical fiscal data, is in line with several recent studies on EMU government bond yield spreads including Gerlach et al. (2010) and Sgherri and Zoli (2009).

-$bidask_{it}$ represents the 10-year bond yield Bid-ask spread, used as a measure of illiquidity. Many authors use bid-ask spreads to capture the liquidity effect in the EMU sovereign bond market. Among them we can point out Barrios et al. (2009), Favero et al. (2010), Gerlach et al (2010), Bernoth and Erdogan (2010). We can expect a higher (lower) value of this spread indicating a fall (increase) in liquidity leading to an increase (reduction) in government bond yield spreads.

-gdp_{it} is the annual growth rate of GDP against Germany. With the inclusion of this variable, I want to show that a decrease in GDP growth makes sovereign debt riskier. Thus, it is expected that an increase (reduction) in growth performance improves (deteriorate) credit worthiness decreasing (increasing) yield spreads.

-$ratings_{it}$ accounts for the role of sovereign credit ratings on government bond yield spreads. Following the work of Afonso et al. (2012), I computed the simple average of the three main credit rating agencies (Standard & Poor's, Moody's and Fitch). The ratings were grouped in 17 categories, where AAA and Aaa observations receive the value 17 while the observations below B- and B3 receive the value 1. This allows

analysing the effect of credit ratings announcements on spreads. It is expected that rating upgrades (downgrades) will decrease (increase) sovereign bond spreads. (See table VII in the appendix).

-$reer_{it}$ is the log of the real effective exchange rate against Germany. This variable generally captures credit risk originating from general macroeconomic disequilibrium and may capture external competitiveness. A positive (negative) change appreciates (depreciates) the currency thus increasing (decreasing) yield spreads.

In addition, I examined whether the adoption of numerical fiscal rules impact on sovereign bond yields. In order to study this subject, I used a Fiscal Rule Index available at European commission`s economic database, covering all types of numerical fiscal rules at all levels of government, as well as indices on the strength and quality of budgetary those rules. The composite Fiscal Rule Index is obtained as follow: First, a Fiscal Rule Strength Index (FRSI) is calculated taking into account five criteria: i) legal base, ii) binding character, iii) bodies monitoring compliance and the correction mechanism, iv) correction mechanisms, and v) resilience to shocks. The composite Fiscal Rule Strength Index is calculated for each rule by aggregating scores, with the use of an equal weighting-scheme. The scores of the five criteria mentioned above are first standardised to run between 0 and 1 and this calculation provides one index measuring the strength of each fiscal rule. Based on this fiscal rule strength index for each rule, a comprehensive time-varying fiscal rule index for each Member State was constructed by summing up all fiscal rule strength indices in force in the respective Member State weighted by the coverage of general government finances of the respective rule (i.e. public expenditure of the government sub sector(s) concerned by the rule over total general government expenditure). In the presence of more than one rule covering the same government sub-sector, the second, third and fourth rules obtain weights ½, ⅓, and ¼, to reflect decreasing marginal benefit of multiple rules applying to the same sub-sector. The assigned weights are mainly determined by the fiscal strength of the rule and its coverage. This approach is similar to the one used by Heinemann et al., (2014).

Finally, following Afonso and Kazemi (2017) work, I checked the effects of ECB intervention through various strands of QE. I covered the standard and non-standard measures of the ECB. Regarding the standard measures, I have included the Longer-term Refinancing Operations (LTRO), which provide longer-term refinancing to the financial sector. I also studied the effects of one finished program, Securities Market Program (SMP) and an ongoing program, Public Sector Purchase Program (PSPP) that is the largest program in terms of cumulative net purchases.

5. Results

In this section, I will present the results obtained through the estimations of the equations explained above. The regression models are estimated over the period between 1999 and 2019 and the country panel includes Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

I started to estimate several determinants of bond yield spreads separately via OLS and Table I reports the results.

Table I: Determinants of yield spreads

	OLS						
	1	2	3	4	5	6	7
Vix	0.003 (0.020)						
Bidask		3.736*** (0.278)					
reer			38.444*** (6.046)				
gdp				-0.459*** (0.038)			
debt					0.153*** (0.019)		
balance						-0.331*** (0.050)	
Fiscal rules							0.314* (0.161)
R-square	0.2647	0.6144	0.3888	0.5718	0.4615	0.0399	0.2837
Nº obs.	210	210	210	210	200	210	200

Note: the asterisks ***, **, * indicate significance at 1, 5, 10% respectively. Fixed effects panel estimates. Dependent variable is the 10-year bond yield spread (relative to Germany).

As we see in table I, when tested individually, except for the volatility index, all determinates coefficients are statistically significant. Thus, on the one hand, vix, bid ask spreads, real effective exchange rate and expected debt have a positive impact on yield spreads. On the other hand, gdp growth and the expected budget balance have a negative impact on yield spreads. The results also show that an increase in fiscal rules impact positively in bond yield spreads.

Due to the predictable correlation between expected debt and expected budget balance, I will not include both variables in the same equation. Hence, in the next step,

I estimate equation (3) via OLS and 2SLS. The results regarding expected debt are presented in table II and regarding the expected budget balance are presented in table III.

Table II: Expected debt and ratings

	OLS		**2SLS**	
	1	2	1	2
Vix	0.009	0.028***	-0.067*	-0.028
	(0.011)	(0.010)	(0.036)	(0.025)
bidask	2.579***	2.491***	4.766***	2.965***
	(0.239)	(0.120)	(0.756)	(0.457)
reer	14.810***	-0.786	-29.419***	-11.301**
	(4.898)	(3.068)	(8.347)	(5.352)
gdp	-0.236***	-0.184***	0.036	-0.248***
	(0.035)	(0.027)	(0.101)	(0.053)
debt	0.055***	0.023*	0.228***	0.043*
	(0.014)	(0.012)	(0.036)	(0.025)
ratings		-0.300***		-0.242***
		(0.020)		(0.028)
R-square	0.7803	0.8366	0.3121	0.8240
Nº obs.	200	200	170	170

Note: the asterisks ***, **, * indicate significance at 1, 5, 10% respectively. Dependent variable is the 10-year bond yield spread (relative to Germany). The instruments used in the 2SLS estimations are the second and third lags of the dependent variable and the first three lags of the independent variables.

The results in table II allow me to conclude that the bid ask spread and expected debt feature the expected coefficient signs and are statistically significant either when I test the equation with the credit ratings and when I test without the credit ratings. Vix, real effective exchange rate and gdp growth present inconsistent results. Finally, concerning average credit ratings, the estimation provides an expected negative coefficient and a high level of significance.

Table III: Expected balance and ratings

	OLS		2SLS	
	1	2	1	2
vix	0.0144	0.0287***	-0.011	0.034
	(0.012)	(0.010)	(0.026)	(0.023)
bidask	2.7341***	2.4911***	2.979***	2.298***
	(0.235)	(0.200)	(0.590)	(0.455)
reer	10.6428**	1.4800	3.731	-2.509
	(4.399)	(3.621)	(9.311)	(7.903)
gdp	-0.2397***	-0.242***	-0.360***	-0.431***
	(0.034)	(0.027)	(0.083)	(0.058)
balance	-0.1376***	0.0346	-0.151***	0.051
	(0.036)	(0.033)	(0.056)	(0.055)
Ratings		-0.3431***		-0.230***
		(0.033)		(0.045)
R-square	0.7718	0.8550	0.7550	0.8177
Nº obs.	210	210	180	180

Note: the asterisks ***, **, * indicate significance at 1, 5, 10% respectively. Dependent variable is the 10-year bond yield spread (relative to Germany). The instruments used in the 2SLS estimations are the second and third lags of the dependent variable and the first three lags of the independent variables.

In table III I report the results with the expected budget balance. In the estimation without the credit ratings, bid ask spread, gdp growth and budget balance present the correct coefficient signs and are statistically significant. On the contrary, I do not found evidence of statistically significant impacts of Vix and real effective exchange rate (2SLS estimation) on yield spreads.

However, when I include the average of credit ratings in the equation, the expected budget balance present a positive coefficient and has no statistical significance. Bid ask spread and gdp growth present the correct coefficient signs and are statistically significant. Once more, I can conclude that the credit ratings have a negative impact on yield spreads because as the table shows, credit ratings have a negative coefficient and are statistically significant.

Moreover, in tables IV and V, I aim to capture further insights regarding the 10-year sovereign bond yields. In order to accomplish that, I estimated the equations (4) and (5) where I included a fiscal rule index and several ECB monetary policy measures, namely Longer-term Refinancing Operations (LTRO), Securities Market Program (SMP)

and Public Sector Purchase Program (PSPP). As in previous estimates, first I include expected debt-to-GDP and then expected budget balance.

Table IV: Debt, fiscal rules and monetary policy measures

	OLS				2SLS			
	1	2	3	4	1	2	3	4
Vix	0.124 (0.012)	-0.001 (0.012)	0.046 (0.035)	0.036* (0.018)	-0.033 (0.028)	-0.070** (0.028)	0.064* (0.033)	0.034* (0.018)
bidask	2.602*** (0.244)	2.610*** (0.248)	13.640*** (3.038)	26.981*** (8.517)	4.133*** (0.671)	3.942*** (0.652)	22.295*** (3.149)	13.155 (10.424)
reer	12.190** (5.453)	13.770** (5.417)	53.195* (29.090)	-12.927** (6.351)	-29.458*** (10.024)	-28.226*** (10.509)	-13.522 (15.692)	-19.887* (9.717)
gdp	-0.244*** (0.036)	-0.201*** (0.037)	-0.023 (0.049)	-0.049 (0.031)	-0.073 (0.090)	-0.087 (0.087)	-0.085** (0.040)	-0.222 (0.140)
debt	0.051*** (0.015)	0.040** (0.016)	-0.036 (0.027)	0.035285* (0.020)	0.190*** (0.032)	0.172*** (0.034)	0.071* (0.035)	0.017 (0.039)
Fiscal Rules	0.183* (0.107)				0.134 (0.153)			
Ltro		0.001*** (0.000)				0.001* (0.000)		
Smp			0.024* (0.014)				0.001 (0.012)	
Pspp				0.000 (0.000)				0.00 (0.00)
R-square	0.7850	0.7996	0.9053	0.3474	0.4709	0.5404	0.8568	0.5056
Nº obs.	190	171	40	45	160	141	25	27

Note: the asterisks ***, **, * indicate significance at 1, 5, 10% respectively. Dependent variable is the 10-year bond yield spread (relative to Germany). The instruments used in the 2SLS estimations are the second and third lags of the dependent variable and the first three lags of the independent variables.

After adding fiscal rules and the quantitative easing measures, results in table IV shows that, among the new variables added, only ltro is statistically relevant in both OLS and 2SLS estimation, although this variable presents a positive sign when I expected a negative one. In the OLS estimation, I see that fiscal rules and the smp have a positive and statistically significant impact on yield spreads.

Table V: Budget balance, fiscal rules and monetary policy measures

	OLS				**2SLS**			
	1	2	3	4	1	2	3	4
vix	0.0144 (0.012)	-0.003 (0.016)	0.037 (0.048)	0.044** (0.018)	-0.033 (0.031)	-0.027 (0.024)	0.074** (0.030)	0.043** (0.018)
Bidask	2.7451*** (0.241)	3.270*** (0.281)	18.761*** (2.406)	26.87*** (8.418)	4.530*** (0.704)	3.095*** (0.576)	14.356*** (4.284)	21.356* (11.992)
reer	9.8761** (4.813)	-8.373* (4.472)	-4.047 (20.155)	-8.687 (5.711)	-20.642*** (7.876)	13.078 (10.400)	78.136 (60.709)	-20.639* (10.344)
gdp	-0.2419*** (0.036)	-0.215*** (0.040)	-0.137** (0.057)	-0.057* (0.031)	-0.235*** (0.080)	-0.243*** (0.086)	-0.068 (0.045)	-0.259** (0.123)
balance	-0.1258*** (0.041)	-0.159*** (0.046)	0.077 (0.122)	-0.179** (0.087)	-0.252*** (0.056)	-0.084 (0.075)	-0.206 (0.179)	-0.111 (0.151)
Fiscal Rules	0.1054 (0.115)				-0.039 (0.157)			
ltro		0.001** (0.000)				0.001* (0.001)		
smp			0.008 (0.010)				-0.014 (0.034)	
pspp				0.000 (0.00)				0.000 (0.000)
R-square	0.7746	0.6788	0.7906	0.3620	0.6041	0.7877	0.9159	0.04942
Nº obs.	200	181	40	45	170	151	25	27

Note: the asterisks ***, **, * indicate significance at 1, 5, 10% respectively. Dependent variable is the 10-year bond yield spread (relative to Germany). The instruments used in the 2SLS estimations are the second and third lags of the dependent variable and the first three lags of the independent variables.

Lastly, in table V I present the results with expected budget balance. Likewise, the results disclosed in the previous table, not all variables have economically expected signs. The ltro is significant and still have a positive impact of sovereign bond yields. Regarding fiscal rules, SMP and PSPP, once more, the results show no significance.

6. Conclusion

In this paper I examined the impact of vix, bid ask spread, real effective exchange rate, GDP growth rate, expected budget balance, expected debt-to-GDP, credit ratings, fiscal rules and some ECB quantitative easing measures on sovereign debt yield spreads using a panel of 10 euro area countries for the period over 1999-2019. I estimated equation 3,4 and 5 via OLS and 2SLS.

Overall, when tested individually, an increase in bid ask spreads, real effective exchange rate and expected debt leads to an increase in yield spreads, while an increase in GDP growth and in expected budget balance leads to a decrease on bond yields. I also found that an increase on simple average of the three main credit rating agencies (Standard & Poor's, Moody's and Fitch) have a negative impact on bond yields.

Regarding fiscal rules, two estimates were made. First, I tested this determinant individually and I found that it affects positively the sovereign bond yield spreads. Then, I estimated equation (4), and only in the estimation via OLS with expected debt was found statistical significance by fiscal rules. As in the first estimation, fiscal rules have a positive impact on yield spreads.

Furthermore, concerning the ECB's monetary policy, LTRO affect positively the yield spreads. To SMP and PSPP I do not found evidence of statistically significance and that could be explained by the fact that a small number of observations are available. It is also important to mention that my results, particularly regarding LTRO do not support the influence of monetary policy in decrease the bond yield spreads.

Bibliography

Acharya, V. V., Drechsler, I. and Schnabl, P. (2014) "A Pyrrhic Victory ? Bank Bailouts And Sovereign Credit Risk", *Journal of finance*, 69 (6), pp. 2689–2739.

Afonso, A. (2010) 'Long-term government bond yields and economic forecasts: Evidence for the EU', *Applied Economics Letters*, 17(15), pp. 1437–1441.

Afonso, A., Arghyrou, M. and Kontonikas, A. (2015) "The determinants of sovereign bond yield spreads in the EMU", ECB Working Paper, No. 1781, ISBN 978-92-899-1594-6, European Central Bank (ECB), Frankfurt a. M.

Afonso, A., Furceri, D. and Gomes, P. (2012) "Sovereign credit ratings and financial markets linkages : application to European data", *Journal of International Money and Finance*, 31(3), pp. 606–638.

Afonso, A., Gomes, P. and Taamouti, A. (2014) "Sovereign credit ratings, market volatility, and financial gains", ECB Working Paper, No. 1654, European Central Bank (ECB), Frankfurt a. M.

Afonso, A. and Jalles, J. T. (2016) "Economic volatility and sovereign yields' determinants: a time-varying approach", ISEG Economics Department WP 04/2016/DE/UECE

Afonso, A., Jalles, T. and Kazemi, M. (2020) "The effects of macroeconomic, fiscal and monetary policy announcements on sovereign bond spreads" International Review of Law and Economics 63: 105924.

Afonso, A. and Kazemi, M. (2017) "Euro Area Sovereign Yields and the Power of QE", ISEG Economics Department WP12/2017/DE/UECE.

Afonso, A. and Rault, C. (2015) "Short- and long-run behaviour of long-term sovereign bond yields", Applied Economics 47 (37) 3971-3993.

Afonso, A. and Tovar Jalles, J. (2018) "Quantitative easing and sovereign yield spreads: Euro-area time-varying evidence", *Journal of International Financial Markets, Institutions and Money*, 58, pp. 208–224.

Ardagna, S., Caselli, F. and Lane, T. (2007) "Fiscal Discipline and the Cost of Public Debt Service: Some Estimates for OECD Countries", The B.E. Journal of Macroeconomics, 7(1).

Arghyrou, M. G. and Kontonikas, A. (2012) "The EMU sovereign-debt crisis: Fundamentals, expectations and contagion", Journal of International Financial Markets, Institutions and Money, 22(4):658–677.

Aßmann, C. and Boysen-Hogrefe, J. (2012) "Determinants of government bond spreads in the euro area: In good times as in bad", *Empirica*, 39(3), pp. 341–356.

Attinasi, M.-G., Checherita-Westphal, C. and Nickel, C. (2009) "What explains the surge in euro area sovereign spreads during the financial crisis of 2007-09?", ECB Working Paper, No. 1131, European Central Bank (ECB), Frankfurt a. M.

Beber, A., Brandt, M. and Kavajecz, K. (2009) "Flight-to-quality or flight-to-liquidity ? Evidence from the Euro-area bond market", The Review of Financial Studies, Volume 22, Issue 3, March 2009, Pages 925–957

Barrios, S., Iversen, P., Lewandowska, M. and Setzer R. (2009) "Determinants of intra-euro area government bond spreads during the financial crisis", European Economy. Economic Papers 388.

Bernoth, K. and Erdogan, B. (2010) "Sovereign bond yield spreads: A time-varying coefficient approach", Journal of International Money and Finance, 31(3), 639-656.

Bernoth, K., Von Hagen, J. and Schuknecht, L. (2004) "Sovereign risk premia in the european government bond market", Working Paper Series 369, European Central Bank.

Codogno, L., Favero, C. and Missale, A. (2003) "Yield spreads on EMU government bonds", Economic policy, Volume 18, Issue 37, Pages 503–532.

Costantini, M., Fragetta, M. and Melina, G. (2014) "Determinants of sovereign bond yield spreads in the EMU: An optimal currency area perspective", *European Economic Review*, 70(0), pp. 337–349.

De Santis, R. (2012). "The euro area sovereign debt crisis: Safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal". ECB Working Paper 1419.

De Santis, R. (2020) "Impact of the Asset Purchase Programme on euro area government bond yields using market news", *Economic Modelling*, 86, pp. 192–209.

Elmendorf, D. and Mankiw, G. (1999) "Government debt", in Taylor, J. and Woodford, M. (eds.), Handbook of Macroeconomics, vol. 1C, 1615-1669, North-Holland.

Favero, C. A., Pagano, M. and von Thadden, E.-L. (2010) "How Does Liquidity Affect Government Bond Yields?", *The Journal of Financial and Quantitative Analysis*, 45(1), pp. 107–134.

Gerlach, S., Schulz, A. and Wolff, G. B. (2010) "Banking and Sovereign Risk in the euro area", CEPR Discussion Paper, n. 7833.

Geyer, A., Kossmeier, S. and Pichler, S. (2004) "Measuring systematic risk in EMU government yield spreads", *Review of Finance*, 8(2), pp. 171–197.

Gómez-Puig, M. (2006) "Size matters for liquidity: Evidence from EMU sovereign yield spreads", *Economics Letters*, 90(2), pp. 156–162.

Haugh, D., Turner, D. and Ollivaud, P. (2009) "What Drives Sovereign Risk Premiums? An Analysis of Recent Evidence from the Euro Area", *OECD Economics Department*, (Working paper n°718).

Heinemann F., S. Osterloh, and A. Kalb (2013), “Sovereign Risk Premia: The Link Between Fiscal Rules and Stability Culture”, ZEW Discussion Paper No. 13-016

Heppke-falk, K. and Hüfner, F. (2004) "Expected budget deficits and interest rate swap

spreads – Evidence for France , Germany and Italy", Deutsche Bundesbank Discussion Paper No. 40/2004.

Jankowitsch, R., Mösenbacher, H. and Pichler, S. (2006) "Measuring the liquidity impact on EMU government bond prices", *European Journal of Finance*, 12(2), pp. 153–169.

Kinateder, H., Wagner, N., (2017) "Quantitative easing and the pricing of EMU sovereign debt", Quarterly Review of Economics and Finance 66, 1-12.

Kumar, M. S. and Baldacci, E. (2010) "Fiscal Deficits, Public Debt, and Sovereign Bond Yields", *IMF Working Papers*, 10(184), p. 1.

Kunovac, D. and Ravnik, R. (2017) "Are Sovereign Credit Ratings Overrated ?", Comparative Economic Studies, 59(2):210–242.

Manganelli, S. and Wolswijk, G. (2009) "What drives spreads in the euro area government bond market?", *Economic policy*, 24(April 2009), pp. 191–240.

Mody, A. (2009) "From Bear Stearns to Anglo Irish : How Eurozone Sovereign Spreads Related to Financial Sector Vulnerability", IMF Working Paper, No. 108.

Robbins, M. D. and Simonsen, B. (2012) "Do Debt Levels Influence State Borrowing Costs?", *Public Administration Review*, 72(4), pp. 498–505.

Sgherri, S., Zoli, E. (2009). "Euro area sovereign risk during the crisis". IMF Working Paper 09/222.

Urbschat, F. and Watzka, S. (2017) "Quantitative Easing in the Euro Area – An Event Study Approach", CESifo Working Paper Series, no. 6709

Appendix

Table VI: Data Description and Sources

Variable	Description	Source
spreds	10-year bond yield spread against Germany bond	ECB
vix	Chicago Board Options Exchange Volatility Index	Chicago Board Options Exchange
bid ask	10-year government bond bid-ask spread	ECB
debt	Expected debt-to-GDP ratio	European Commission
balance	Expected government budget balance-to-GDP ratio	European Commission
gdp	GDP growth rate	World Bank
reer	Real Effective exchange rate log against Germany	World Bank
ratings	Credit ratings (Average of Fitch, Moody´s, S&P)	Trading Economics
Fiscal Rules	European Commission's (2006) Fiscal Rule Index	European Commission
SMP	Nominal amount of securities markets programme	ECB
PSPP	Net purchases of public sector securities under the public sector purchase programme	ECB
LTRO	Longer-term refinancing operations	ECB

Table VII: Ratings Transformation

Ratings			Linear Transformation
S&P	Moody´s	Fitch	
AAA	Aaa	AAA	17
AA+	Aa1	AA+	16
AA	Aa2	AA	15
AA-	Aa3	AA-	14
A+	A1	A+	13
A	A2	A	12
A-	A3	A-	11
BBB+	Baa1	BBB+	10
BBB	Baa2	BBB	9
BBB-	Baa3	BBB-	8
BB+	Ba1	BB+	7
BB	Ba2	BB	6
BB-	Ba3	BB-	5
B+	B1	B+	4
B	B2	B	3
B-	B3	B-	2

CCC+	Caa1	CCC+
CCC	Caa2	CCC
CCC-	Caa3	CCC-
CC	Ca	CC
		C
SD	C	DDD
D		DD
		D

1